King County's SciFYI

King County
Department of Natural Resources and Parks
Water and Land Resources Division

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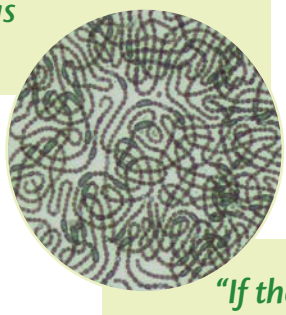
Blue green algae—monitoring for toxic cyanobacteria

There has been an increasing awareness of potential health risks posed by freshwater cyanobacteria, also known as "blue-green algae."



By Debra Bouchard, Limnologist/water Quality Planner with King County DNRP

Cyanobacteria toxicity monitoring

In the fall of 1997, a toxic bloom in Lake Sammamish led to posting advisories at Lake Sammamish State Park, Idylwood Park, and Marymoor Park. An extensive study conducted in 1999 revealed a toxin producing bloom despite the absence of a visible accumulation of cyanobacteria (Johnston and Jacoby, 2003). These events prompted the Science and Technical Support Section to include cyanotoxin monitoring as part of its Major Lakes Monitoring and Swimming Beach Monitoring programs.

"If there is a blue green algae bloom, keep pets and children out of the water!"

Mass accumulations or "blooms" of cyanobacteria in freshwater ecosystems are primarily caused by nutrient enrichment, particularly phosphorus. Cyanobacteria blooms can cause surface scums, decreased water column transparency, dissolved oxygen depletion and unpalatable drinking water due to taste and odors.

Some cyanobacteria also produce toxic compounds ("cyanotoxins") that have caused livestock, wildlife and pet fatalities worldwide (reviewed by Carmichael 1994; Chorus 2001). Although many cyanobacteria blooms are not toxic, a bloom that is not toxic one day may become toxic during the same growing season (Ecology 2007). Toxin groups and the cyanobacteria generally known to produce them are listed in Table 1.

Public health concerns

Microcystins are the most commonly tested and detected cyanotoxins in Washington. Microcystins damage liver tissues, and at high doses can cause liver

Table 1. General features of cyanotoxins. (Modified from Chorus and Bartram 1999)

TOXIN GROUP	PRIMARY TARGET ORGAN IN MAMMALS	CYANOBACTERIAL GENERA
Microcystins	Liver	Microcystis, Anabaena, Planktothrix (Oscillatoria), Nostoc, Hapalosiphon, Anabaenopsis
Nodularian	Liver	Nodularia
Anatoxin-a	Nerve Synapse	Anabaena, Planktothrix (Oscillatoria), Aphanizomenon
Anatoxin-a (S)	Nerve Synapse	Anabaena
Aplysiatoxins	Skin	Lyngbya, Schizothrix, Planktothrix (Oscillatoria)
Cylindrospermopsins	Liver	Cylindrospermopsis, Aphanizomenon
Lyngbyatoxin-a	Skin, G.I. Tract	Lyngbya
Saxitoxins	Nerve Axons	Anabaena, Aphanizomenon, Lyngbya, Cylindrospermopsis
(LPS)	Potential irritant; affects any exposed tissue	ALL

failure and death (Carmichael 1994). In addition, microcystins are suspected tumor-promoters and teratogens (Falconer 1998). These toxins have been associated with elevated rates of primary liver cancer in people drinking waters with high densities of cyanobacteria (Yu 1989).

While microcystins appear to be more common than neurotoxins, neurotoxins (for example anatoxin-a) are notoriously potent and rapidly acting poisons that have caused severe animal poisonings in North America, Europe and Australia (World Health Organization 2003, Botana 2007). Depending upon the size of the animal and amount of the neurotoxin present, illness or death may occur within a few minutes to a few hours after exposure. Signs of neurotoxin poisoning are staggering, paralysis, muscle twitching, gasping, and convulsions – all potentially leading to death.

Regulatory status of cyanotoxin criteria and guidelines

State health officials are concerned that the rate of occurrence of toxic algae blooms appears to be increasing and leading to the possibility of increased human and animal exposure to cyanotoxins (DOE 2007). In 2005, the Washington State Legislature established funding for a Freshwater Algae Control Program (RCW 43.21A.667) through the Department of Ecology (DOE) to assist local governments in the management of freshwater algae problems. As part of this program Ecology partnered with the Washington Department of Health (DOH) to develop recreational guidelines values for cyanotoxins. More information about this three-tiered management approach can be found at the DOH Web page: http://www.doh.wa.gov/ehp/algae/guidelines.htm.

Science and Technical Support Section monitoring program

Cyanotoxin monitoring efforts of the STS section along with the King County Environmental Laboratory staff include one deep-water station from lakes Washington, Sammamish, and Union and all 18 swimming beaches. These samples are collected weekly from March through October.

Until recently, investigations of cyanotoxicity have focused on microcystins due to their widespread occurrence. However, the increasing detection of anatoxin-a in western Washington lakes (e.g., American Lake, Pierce County, December 1989 and 2007; Kitsap Lake, Kitsap County, October 2001; and Jefferson County 2006) in association with animal deaths has prompted King County to expand it's cyanotoxicity monitoring to include this neurotoxin beginning in 2009.

King County's cyantoxicity monitoring effort will provide decision-makers with information and recommendations regarding recreational water use during cyanobacterial blooms and will lead to improved management of county lakes for the protection of human health.

For more information, visit the King County Lake Monitoring web pages: http://dnr.metrokc.gov/wlr/waterres/lakes/ or contact Debra Bouchard or Jonathan Frodge, King County Department of Natural Resources and Parks, debra.bouchard@kingcounty.gov and jonathan.frodge@kingcounty.gov

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Send questions, comments and future story ideas to:
Kate O'Laughlin - kate.olaughlin@kingcounty.gov, 206-8363 or
Jim Simmonds - jim.simmonds@kingcounty.gov, 206-1986

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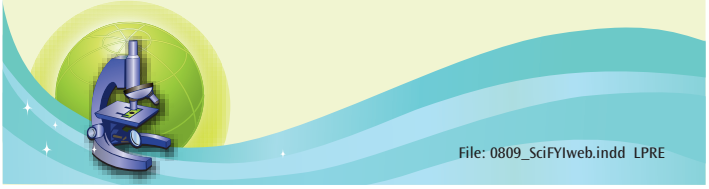

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